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PROTOTYPE HANDLING PROCESS IN SUBCONTRACTING PROJECTS

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PROTOTYPE HANDLING PROCESS IN SUBCONTRACTING PROJECTS

The main goal of this research project was to create an official process for prototype handling in the subcontracting projects in the mobile phone development. An additional goal was to develop possible improvement ideas for prototype handling in the subcontractor prototype management and deliveries.

The logistic process creation and improving theories were acquainted including some points about the importance of the process ownership. In addition, the research project included some theory about the safety aspects of the logistics chain.

In the practical part of the thesis, Project X is introduced. In this project, the prototype handling and management as well as other project management incidents were done as a model example of very poor and bad practices, such as other project management problems. The problems in this project were solved and working improvement ideas were suggested for developing the project related items further.

As result of the research project, a new official process was created for prototype handling and management in subcontracting projects. All created official process documents are meant only for Nokia internal usage, and therefore only the public part of the process documents are presented in this theoretical part of the work.

Some improvement suggestions which should be taken in use within a short notice are presented in the final part of this research project. A short summary of the complete full research is gathered in the end of the thesis.

Keywords

prototype, subcontracting, process, delivery, security, logistics

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Työn tavoitteena oli luoda virallinen prosessi matkapuhelimien prototyyppien toimituksiin ja hallintaan alihankintaprojekteissa. Lisäksi työn tarkoituksena oli kehittää mahdollisia parannusideoita toimintasuunnitelmiin ja prototyyppien toimituksiin.

Työssä tutustuttiin prosessin luomisen ja parantamisen teorioihin ja logistisen prosessin omistajuuden tärkeyteen. Lisäksi työssä perehdyttiin tavaran toimituslogistiikan turvallisuuspuolen asioihin.

Käytännön puolella esiteltiin esimerkkiprojekti X, jossa prototyyppien käsittely ja hallinta oli tehty malliesimerkkinä täysin väärin, kuten kaikki muutkin projektin johtamispuoleen liittyvät asiat. Tämän projektin ongelmat korjattiin ja luotiin toimivat jatkokehityssuunnitelmat projektin toimivuuden kehittämiseen.

Tutkimuksen lopputuloksena luotiin uusi virallinen prototyyppiprosessi alihankintaprojektien prototyyppien toimituksiin ja hallintaan. Luodut viralliset prosessimateriaalit on tarkoitettu vain Nokian sisäiseen käyttöön, joten ne on esitelty vain julkisilta osiltaan työn kirjallisessa osuudessa.

Työn loppuosuudessa käydään läpi parannusehdotuksia, jotka tulee ottaa käyttöön lähitulevaisuudessa. Työn loppuosaan on kerätty lyhyt kooste koko suoritetusta tutkimuksesta.

Asiasanat

prototyyppi, alihankinta, prosessi, toimitus, turvallisuus, logistiikka

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ABBREVIATIONS

PLA	Product Loan Agreement
UK	United Kindom
R&D	Research and Development
SW	Software
MP	Mobile Phones
AWB	Air Way Bill

FOREWORD

This Master's Thesis is made for the Mobile Phones department of Nokia Corporation. The thesis materials will be used globally in the Nokia Mobile Phones software development subcontracting projects. The work was supervised by Mr. Kari Laitinen, Principal Lecturer of Oulu University of Applied Sciences, and the supervisor in the company was Mr. Janne Lyly, MP Prototype Manager.

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Oulu, Spring 2012

Timo Kälkäinen

1 INTRODUCTION

This chapter includes short introduction for the thesis commissioner and the definitions for the prototype and subcontracting. Project background information and definition are also introduced in this chapter. Thesis structure is presented in the end of the chapter.

1.1 Nokia Mobile Phones

The focus of the Nokia Mobile Phones team is on bringing a modern and affordable mobile experience to people around the world. In particular, the team leverages its innovation and strength in the growing markets to enable an affordable access to the internet and applications and – in many cases – provide the people their first ever internet experience. (About Nokia, 2012.)

1.2 Prototype

A prototype is an executable model of a system that accurately reflects a chosen subset of its properties, such as display formats, computed results, or response times. Prototypes are useful for formulating and validating requirements, resolving technical design problems, and supporting computer-aided design of both software and hardware components of the proposed systems. A prototype may not satisfy all of the constraints on the final version of the system. To be effective, partial prototypes must have a clearly defined purpose that determines what aspects of the system must be faithfully reproduced and which ones can safely be neglected. Prototypes facilitate the requirements phase for any type of software if the requirements have changed from the previous version, which is usually the case. (Kordon F & Luqi, 2002, 817-821)

1.3 Subcontracting

Subcontracting is the act of transferring some of a company's recurring internal activities and decisions rights to outside providers, as set forth in a contract. Because the activities are recurring and a contract is used, subcontracting goes beyond the use of

consultants. As a matter of practice, not only are the activities transferred, but the factors of production and decision rights are often, too. The factors of the production are the resources that make the activities occur and include people, facilities, equipment, technology and other assets. Decisions for making decisions over certain elements of the activities are transferred. (Greaver, 1999, 3)

1.4 Background of the project and project definition

Delivering prototype phones and R&D material for the Nokia subcontractors is currently based on the subcontracting specific Nokia project leader's own knowledge. Typically all subcontracting project leaders are not so familiar with the Nokia security policies and prototype delivery methods available for subcontractors. In Nokia Mobile Phones, the development is being expanded to various subcontracting projects in order to prioritize the tasks and assignments internally in a more efficient way.

This master's thesis includes a study and some suggestions to the official global subcontracting process for delivering and tracking prototypes in subcontracting projects lead by the Nokia Mobile Phones department.

For this thesis Project X is used as a model example of a very poor and bad way of handling prototype phones and R&D material deliveries in a subcontracting project. The current state of the example project is that everything have to be started again from very scratch in every area of managing this project, since the previous Nokia project leaders did not meet the expectations of the handling this project.

During the study project a prototype related problems are fixed in Project X and an official process and guides are created on how to handle prototypes and other R&D material in an official way in the Nokia Mobile Phones subcontracting projects. Some Project X specific future development ideas are also suggested.

Outcome of this master's thesis is an official process and the needed backup material for handling prototypes and other R&D material in Nokia subcontracting projects. This thesis work includes an example case specific study for handling R&D material and some common theory about developing and evaluating processes and delivery logistics including safety aspects.

1.5 Structure of the master's thesis

This master's thesis is divided into nine chapters. The first chapter includes an introduction of the Nokia Mobile Phones organization and definitions for the prototype and subcontracting concepts. A short overview is also presented on the project background including the expected outcome of this thesis. Chapters 2-4 are the theoretical parts of the thesis.

The second chapter is about a theory of designing and improving processes by using a systematic approach for the process analysis. The analysis is divided into six steps which are followed when creating a new process systematically.

The logistic process is defined in the third chapter. The third chapter includes a basic content of the logistic process and gives a short preview about the idea of a logistic process in the company, the customer area communications and the delivery optimization of the goods.

Security is one of the major incident when delivering prototypes globally, and therefore the security aspects of the logistic chain are handled in the fourth chapter. In this chapter there is a definition of the logistics states of the package delivery in the delivery chain. The risk points in the logistic chain are highlighted out from the delivery.

An efficient prototype delivery process definition is covered in the chapter five. This gives a general picture of the process and the focused key criterias affecting there. This definition is also followed in the new prototype process for subcontracting projects.

Chapter six presents Project X – the example project with its problems. It includes some background information about the project and the study including a problem solving part of the project. The problem solving is done by studying the project details at a very deep level. After the problems have been solved, the chapter describes the current state of the project and some future development ideas for the Project X prototype handling problems.

Chapter seven presents at a public level a new prototype handling process in the subcontracting projects. All detailed company specific documentation that is made for

this thesis is classified as Nokia internal material. The chapter is divided into different key criteria which are recognized as the key criteria for an efficient prototype handling process in the subcontracting projects.

The Improvement suggestions and solutions are described in chapter eight. This chapter also points out the importance of the security matters when handling prototype devices.

The final chapter is a short summary and thesis writer's thoughts of this thesis and the project development work.

2 DESIGNING AND IMPROVING PROCESSES

Processes are perhaps the least understood and managed aspect of a business. A firm cannot gain a competitive advantage with faulty processes. Work is done somehow, but not in a good way. The process keeps rolling on. Most processes can be improved if someone thinks of the way and it is effectively implemented. A long-term success comes from managers and employees who understand and follow their business in detail. The following sections go through a systematic approach for the process analysis. This method analyses the process with different steps. (Krajewski 2005, 132.)

2.1 Systematic approach for process analysis

When taking a systematic approach for the process a six-step blueprint for the process analysis can be followed. Figure 1 demonstrates the six-step blueprint states and the functionality in the systematic approach to the process analysis.

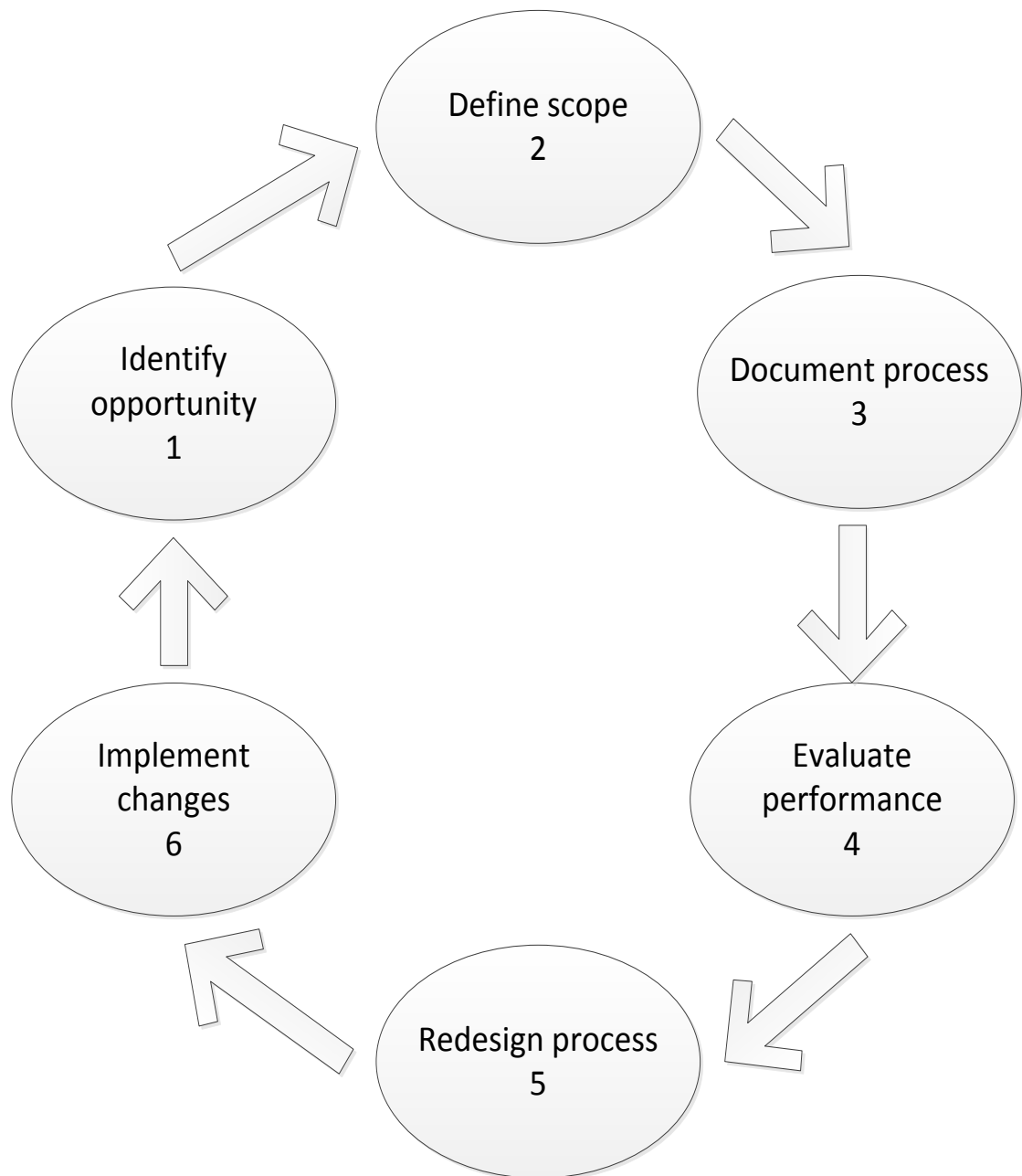


Figure 1. A systematic approach to Process Analysis

A process analysis is the documentation and detailed understanding of how the work is performed and how it can be redesigned. The intent is to continually improve the processes by judging their performance on multiple different measures. Analysis begins with identifying a new opportunity for improvement and it ends with implementing a revised process. Finally the last step leads to the beginning of the analysis, creating a cycle of continual improvement. (Krajewski 2005, 133)

2.1.1 Step 1: Identify opportunities

In order to identify the opportunities, a particular attention must be given to the four core processes: supplier relationship, new service/product development, order fulfillment, and customer relationship. Each of these processes and items related to those are involved in delivering the value to the external customers. Are the customers satisfied with our service or the product that they receive, or are there possibilities to do some improvements? Customer satisfaction must be monitored periodically with a formal measurement system or with informal checks or studies. (Krajewski 2005, 133.)

Another way to identify opportunities is by looking at the strategic incidents. Are there gaps between the process's competitive priorities and its current competitive capabilities? Do multiple measures of cost, top quality, quality consistency, delivery speed, and on time delivery meet or exceed the expectations? Is there good strategic fit in the process? Similar questions should also be asked for manufacturing the process regarding the strategic fit between the process choice, volume and customization. (Krajewski 2005, 133.)

One more way to identify opportunities is from employees who actually perform the process or from its internal suppliers or customers. They should be encouraged to give feedback and ideas to managers and staff specialists. There could also be some formal suggestion system where employees can leave their ideas. This voluntary suggestion system should be followed by some specialist who evaluates the proposals and makes sure that worthy suggestions are implemented to the process and gives feedback and rewards to employees according to proposals. (Krajewski 2005, 133.)

2.1.2 Step 2: Define scope

After the opportunities have been identified, the second step is to define the scope of the process to be analyzed. Is it a broadly defined process that stretches across the whole organization, involving many steps and many employees? Or is it a more narrow nested subprocess that is only a part of one person's job? Limiting it to a small subprocess can overlook important breakthroughs in the process design. A too broadly defined process

which overuses the available resources is doomed, because it increases frustration without producing any results. (Krajewski 2005, 134)

The assigned resources that the management has assigned for improving or re-engineering the process should match the process scope. For a small nested process involving only one employee, the employee maybe asked to redesign the process herself. For a large re-engineering project that deals with a major core process, managers typically establish at least one design team. A design team consists of knowledgeable, team-oriented individuals who work at one or more steps in the process, do the process analysis, and are more motivated to make the necessary changes. Other resources may be internal or external specialist facilitators who does not work with the process. These facilitators know the process analysis methodology, and they can guide and train the design team. If the process is extensive and cuts across several departmental lines, a steering team should also be formed. It consists of several managers from the various departments, headed by a project manager, who oversees the process analysis. (Krajewski 2005, 134.)

2.1.3 Step 3: Document process

Once the process scope is established, the analyst should document it. The documentation begins by developing a list of the process inputs, suppliers, outputs and customers. This information can be shown as a diagram, or with a more detailed table. After the list has been finished, it is time to move on to the understanding the different steps performed in the process, using one or more of the diagrams, tables and charts available on the process. When breaking down the process into the steps performed, the analyst notes the degrees and types of the customer contact, process complexity, and process divergence along the various steps in the process. Attention is also given to what steps are visible to the customer and where the work in the process is handed off from one department to the next. (Krajewski 2005, 134.)

2.1.4 Step 4: Evaluate performance

It is important to have some performance measures that can be used for evaluating the process and finding the clues how it can be improved. Metrics are performance measures that are established for the process and the steps within it. A Good starting point is a competitive priority which has to be made specific. The analyst creates multiple measures of quality, customer satisfaction, throughput time, cost, errors, safety, environmental measures, on-time delivery, flexibility etc. (Krajewski 2005, 134.)

After metrics are identified, and information is collected on how the process is currently performing on each one. The measurements can be as simple as making a reasoned guess, asking a knowledgeable person, or simply taking notes while observing the process. More extensive studies could involve collecting data for several weeks, consulting the cost accounting data, or checking the data recorded information systems, In addition the techniques for analyzing the waiting times and delays can provide important information. Another valuable techniques include work sampling, time studies, and a learning curve analysis. (Krajewski 2005, 135.)

2.1.5 Step 5: Redesign process

Documenting a process is not adding value to the process itself, but it gives a better understanding about it and then it can be improved more easily. A careful analysis of the process and its performance on the selected metrics should uncover the disconnects, or gaps, between the actual and desired performance. Performance gaps might be caused by illogical, missing or extraneous steps. They can be caused by a poor selection of metrics that can reinforce the silo mentality of individual departments when the process spans across several departments. The silo mentality means that a department focuses on its own tasks without understanding the role and processes of the departments located outside of its own organization. The analyst or design team should dig deep for finding the root causes of such performance gaps. (Krajewski 2005, 135.)

Having identified the performance gaps, it is necessary to change the analytical thinking to a creative thinking by creating a long list of ideas about possible improvements for

the process. A questioning and critical attitude is needed to spot the breakthroughs. These ideas are then gone through and analyzed. Suitable ideas for the new process are the ideas where the benefits exceed the costs. A new design should be documented as proposed. The new documentation should make clear how the revised process works and the performance that is expected for the various metrics. (Krajewski 2005, 135.)

2.1.6 Step 6: Implement changes

Once a new process is approved, it can be implemented to use. The Implementation is more than developing a plan and carrying it out. Many processes have been redesigned effectively, but never been implemented. People often resist change, by arguing that “we have always done it that way” or “we have tried it before”. A widespread participation in the process analysis is essential since it helps to build commitment for the new process. It is easier to implement something which is partly one’s own idea. In addition special expertise may be needed, such as developing software. New jobs and skills might be needed to get changes done and it might require some new investments in new technology. The implementation of any new process or redesigned process is a project, often with complex relationships between the activities and a significant allocation of the resources. The management or steering committee must make sure that the implementation project proceeds according to the schedule. The management support and encouragement are essential, particularly if the extent of the change is large. (Krajewski 2005, 135.)

3 LOGISTIC PROCESS

The Logistic process is an important part of customer service. In a successful business the problem is always a question about know-how and making such product service combinations which are wanted by the customers. A customer service process is combined from different value adding actions. It is called a core process of the business operations. (Sakki 2003, 23.)

When the delivery of goods or service is combined to one entity around different parts of the company, it creates a logistic process. The process starts from the customers and the information flow goes first via the company to the supplier. The amount of goods moves to the opposite direction from the supplier to the customer handled via the company. (Sakki 2003, 23.)

The logistic process flows across several responsibility areas in the company and it is an equal part of the marketing and material functions. The logistics is not only a functionality moving goods further in the chain of value. It is a process which consists of many much dispersed work functions which support the business core process execution. (Sakki 2003, 23)

Removing barriers between the customer and the manufacturer is a task for the marketing channel. The logistics has a key role on that. The logistics is about handling the goods as well as moving and storing them. It joins to the material flow between the companies. In addition, logistics is also handling of goods related information and payment, money and capital flow investment and realizations. (Sakki 2003, 24)

A great deal of communications between people is included in the logistic process and it is related to the working tasks of the employees. In general, at least a half of the logistics is clearly administrative or office work. This logistics can commonly be called as guidance. The administrative work is done via phone, e-mail and computer in the office. In summary, the logistics is a flow of goods and related information including the money flow guidance and realization. (Sakki 2003, 24.)

It is important to notice that the logistic process meets the customer in several points. That is the reason why the realization of the logistics is one of the central success factors. Every company can enhance its competitiveness when it can manage its logistic process better than its competitors. It is crucial to have a right viewpoint for logistic actions. Those actions should be planned from the beginning to the very end of the customer starting points and consideration of the customer needs. The logistics is an important part of the customer service, and the realization of the logistics must be evaluated according to the extra value given to the customer. That is the reason why the logistics has become a big part of the marketing and material functionalities. (Sakki 2003, 24.)

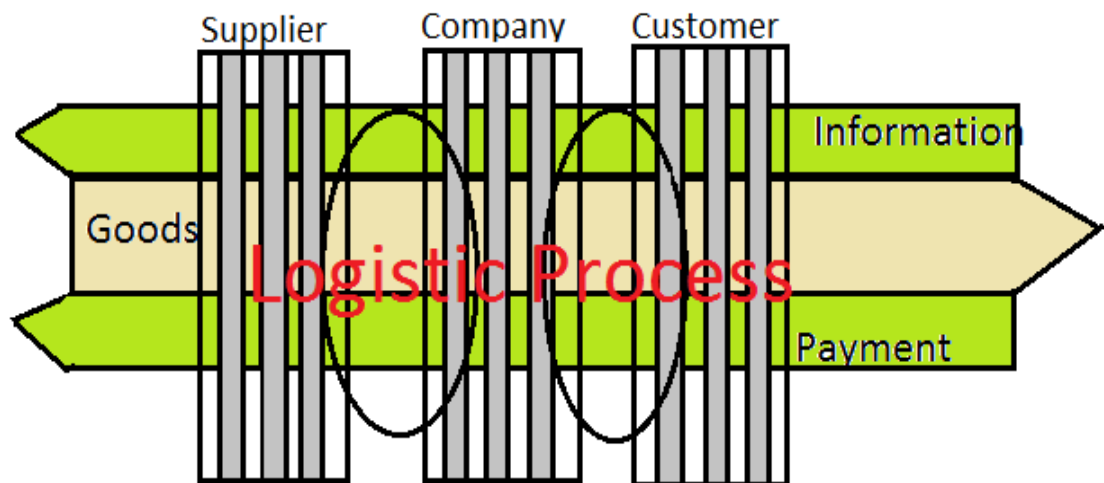


Figure 2. Logistic fabricates process, where information, goods and payments are moving. Logistics is equal amount of marketing and material functionalities

The goals of logistics were used to be focused on the cost efficiency. Now the focus is also in the fast lead-times and developing customer service. The costs and the price are still an important competition factor, but in the addition the lead-times should be minimized. The increase of the delivery speed and shorten the reaction time are also in focus now. The logistics is not only “an money saving” action but it is also an important part of the customer-oriented strategy. (Sakki 2003, 25.)

The logistics goals can be compacted to the following two main points:

- *External or service efficiency*: Constantly seeking better ways of working so that more solutions are offered to the customer instead of offering goods only. Helping the customer to increase his/her own internal and external efficiency.
- *Internal or cost efficiency*: Avoiding extra handlings, decreasing the stock sizes widely by improving the work and capital productivity.

(Sakki 2003, 25.)

3.1 Process Owner

It is important to define the process ownership. Otherwise the scattered tasks in the logistics functions do not form a system that is consistent and controlled enough. The logistic process must be designed from the customer point of view and that is the reason why the process owner should be close to the customer. (Sakki 1999, 27.)

In the collecting logistic, the owner or the person defined by the owner is the project manager, who is close to the actual production. In the delivery logistics the process owner is typically a sales or product manager. The process owner is responsible for the process efficiency and developing it further according to the organization goals. Special attention should be paid to the gateways of the sales department. (Sakki 1999, 27.)

The process owner can also be a group of employees, who are performing sequential phases in the manufacturing. Such a group is called a team. It consists typically about 5-10 employees. They have a common goal and all team members are considered as jointly and separately liable for reaching the goal. By making teams, the company tries to get more flexibility and adapting sensitivity to the customer requirements and competitor actions. (Sakki 1999, 27.)

4 SECURITY ASPECTS OF LOGISTICS

The logistics is a stream of goods and an information flow, and a logistics chain consists of many different actors. The data management and anyone who has information of different parts of the logistics chain are especially important from the point of view of the logistics security.

The logistics security is covered in many parts of the delivery chain. For example, the company's security advisory board has determined the company's security areas. The logistics security is a wider system. The logistics security also includes daily areas, such as road safety as well as transport and storing properties for goods. (Vesterinen 2011, 24.)

During the last few decades special attention has been paid to the functionality, flexibility and speed of logistics in Finland, Europe and globally. The operation models are clear and easy to adapt. This is a strength from the point of view of the logistics but a weakness from the point of view of the security. (Vesterinen 2011, 24.)

Logistics areas of operation and security have been expanded, and special attention must be focused on the security since it has become more complex. Earlier there were operations in Finland, then in Europe, and now in the whole world. The length and complexity of the delivery chain increases value of the goods in the delivery. Different external threats and occurred crimes are affecting the logistics security.

4.1 Logistics chain

The logistics chain begins from the recipient's purchasing department, where decisions about the company's purchases are done. The purchase department defines what is purchased and from whom, and what are the terms of delivery. The terms of delivery specify who is responsible for the delivery. (Vesterinen 2011, 25.)

Next in the delivery chain there is the sender's stock and after that the forwarding agency, the transport company, harbor, shipping company, etc., depending on the sender's and recipient's locations. (Vesterinen 2011, 25.)

From the point of view of the security there are many information holders, and mastering the whole information flow is difficult. From the point of view of receiver it is important that goods arrive at the right moment with the right price, complete and usable. The base of the security is working, and the information about the goods is secured during the whole logistics chain. (Vesterinen 2011, 26.)

In the logistics the information moves before the actual delivery of the goods takes place. Nowadays, the electronic information about the delivery reaches the receiver before the goods are physically moved. This includes the information of the units and the schedules of the goods transport. The following chapter describes how the main information and delivery flows at the basic level. The process can change according to the delivery method. (Vesterinen 2011, 27.)

The logistic chain is as strong and safe as its weakest link. One weak link can affect significantly the whole security chain. Every company, which is participating in the delivery, must pay attention to the whole delivery, how they affect the safety of the whole delivery and especially how they affect the people working in the chain.

If the delivery chain becomes very long and complex, it may include different kind of cultures and tradings. If the whole delivery chain is in the control of the company, it has better possibilities to anticipate the possible problems in advance. (Vesterinen 2011, 27.)

The logistics safety consists of several different areas. When the goal is that the goods are undamaged and at the right time in the right place, many risk factors can affect the result. The parts responsible for the logistics chain should take care of all possible risk factors which can occur in the delivery chain. In addition to the criminal risks it also includes many more likely risks which can cause problems in the logistics. These problems include geographical and climatical threats, political instability and many other incidents, such as traffic accidents. (Vesterinen 2011, 27.)

Nokia is dealing mostly with international deliveries so and that is why logistic and that is why the functionality and severity of the logistics chain must be ensured in the global scale. Table 1 describes typical information flow and stream of goods used in the global export delivery at the general level. In the left columns the information flows are stated and the right columns states of goods streams are described.

TABLE 1. Logistics chain in global export delivery

Information Flow			Stream of goods
Receiver Purchase department Receiver purchase department is the information flow startup point. They will make the order from the sender			Manufacturing or stock Physically item is in the stock or in physical manufacturing
Sender, order and warehouse sender gets the order about the goods and when needed, delivery method and which courier should be used for delivery			stock compiling and shipping department After stock compiling goods are located in the shipping area, where those can be picked up. It is ready with shipping labels and all shipping documents are done
Logistic service courier after goods are loaded, notification will be done, where is information about the delivery time and which units will be used in shipping company, delivery port and logistics service destination unit			After loading goods, are moving either in same transportation vehicle or depending on the system it might include some terminal handling
Forwarding Agency			
Customs			
Logistics Service company receiver country office	Ship-, Air or railway company requires information about the delivered	Harbour, Airport or railway Harbour, Airport or railway authorities require information about the delivered goods	
Domestic delivery			Collection delivery
			Terminal handling
			Takeoff terminal
			Domestic framework
Harbour, airport or Railway terminal in destination country Authorities needs information about incoming goods			Destination terminal (outbound clearance teminal)
Logistic service courier destination country			Harbour, airport or railway terminal, where delivery stops for a while
Forwarding Agency			Ship, airway or railway company
Customs			
Shipping courier in destination country			
Receiver			Harbour, airport or railway terminal, where deoivery stops for a while
			Shipping agent
			Forwarding agency
			Customs
			Shipping courier
			Receiver

4.2 Security in the delivery chain

The security of the delivery chain is a way to ensure that the agreed delivery arrives on time. The products and raw materials have a great demand and sometimes shipments have reached at criminal hands. Otherwices even accidents, a fire, climate catastrophies, the political situation in some countries or even a state of war could cause delivery breaks. When care has been taken of the delivery chain safety, a better delivery reliability can be ensured. Importance of security in delivery chain has increased since sizes of warehouses have been decreased and when the delivery time has become a critical element. (Vesterinen 201, 37.)

4.3 Risk points in logistics

The logistics risk points are in the places where the stream of goods stops moving. The stops might be caused by a driver's break, harbor, terminal or some other part in the logistic chain. The stream of goods can also be stopped in warehouses, and this can also cause risks in the logistics.

The point of view of information security, there are countless amounts of different kinds of information systems where data is logged before the stream of goods arrives. This also causes logistic riskpoints.

The logistics riskpoints should be clarified when making agreements of the delivery. Riskpoints should be clarified according to the criticality of the product or goods. At the same time it is usefull to define an alternative product or route which can be used to decrease the delivery risk.

5 DEFINITION OF EFFICIENT PROTOTYPE PROCESS

In the prototype handling products and services are delivered. Products are prototypes and their accessories. The services include information about the product features, timetables, software versions, product tracking, delivery and possible fixes.

An efficient prototype process should fill the following criteria:

- *Cost optimization:* Cost optimization is one of the main goals for the new process. This process should include tools and means to enable the cost savings compared to the time before the new process.
- *Quality:* Even the quality in handling in prototypes for the subcontractors is more important than the top quality. This process should keep the subcontractor happy with the service but not offer a too special, expensive quality and prototype amounts, which can cause overkills for the orders and demands.
- *Time:* Staying within the timelines of the agreed schedules is very important since the subcontractors affect the time of the market schedules. The subcontractors should have the needed prototypes and accessories in their hands exactly when they need them. The delivery time is really important and should work as fluently as possible as the operations are global in a fast development area.
- *Flexibility:* It is important to be aware of all prototypes in the development and have a possibility to deliver some rare prototypes, too, to the subcontractors if they have some unexpected urgent need for those. There should also be some extra backup resources available if some urgent backlog need occurs.
- *Security:* It has to be ensured that the subcontractors are aware of the Nokia security policies. The prototype deliveries must be done according to the Nokia prototype policy and the deliveries must be done in a secure way so that all

prototypes are always tracked. The prototypes must be handled according to the Nokia security policy in the subcontractor premises.

All of those five listed criterias should be included when creating a new efficient official prototype handling the process in the subcontracting projects.

6 CASE PROJECT X

This chapter includes background information of Project X, including some background study and the problems solving part for the project. In the end of this chapter the current state of the project is presented.

6.1 Background information of Project X

The example Project X was started early in 2010 by one Nokia project leader in Oulu. Project X was led from Nokia's side by Nokia UK while the actual subcontractor was located in India and Germany.

In the starting phase of the project four Nokia employees were nominated to handle Project X from Nokias side. On the subcontractor's side there were twentyone persons working in the India office and seven persons in Germany.

In the startup phase of the project, The Nokia project leader ordered many prototypes and other R&D accessories in a random manner from the Nokia prototype management using a high priority business reason. The prototype order caused great deal of extra effort from the prototype management, because the order was big and most of the ordered prototypes were already ordered and delivered from the product programs. The prototype management had to organize the ordered prototypes from the Nokia internal development sites causing some lack of prototypes in the internal development units.

After the prototypes and other R&D materials had been delivered to the Nokia project leader, he sent those straight to the subcontractor without following the Nokia security policy.

During the spring 2010 the Nokia Southwood developers and test engineers transferred their competencies to the Subcontractor and the actual SW development started in the subcontractor's project. Problems were found during the competence transfer, and there were great difficulties in communicating them to the subcontractor. After the summer 2010 the Nokia management noticed that the current setup of Project X was not working at all. Nokia was spending great deal of money in the project, but the outcome was not

what was agreed and planned. During that time Nokia had to make the decision if the subcontracting project should be continued or ramped down. The Nokia management saw still good opportunities with this project after they had studied what went wrong with this project.

During the autumn 2011 the Nokia management moved the project leadership to the Oulu site and nominated single experienced contacts in all project management areas. Also, a local proto specialist from Oulu was nominated to lead the prototype deliveries for this project.

6.2 Studying the prototype problems in the Project X

Studying the prototype problems in the project started from Nokia's side by seeking information on all of the prototypes sent to the subcontractor. From the very beginning it was noticed that the prototypes were sent to the subcontractor from various places without making official requested PLAs (Product Loan Agreement) for the deliveries. The Nokia security policy requires that there must be official PLA documents for all R&D material delivered to the subcontractor. PLA documents must be stored in a secure place where they can be found if any legal problems occur with the subcontractor.

The previous project members pointed out that one of the biggest gaps was caused by the delayed prototype deliveries. When the subcontractor project member requested a prototype, it took more than one month to get the prototype to the subcontractor's premises. That delay is not acceptable since it causes too big a delay in the software development chain.

Another problem was also found in the information flow area. The subcontractor did not necessarily know what they needed and the Nokia project leaders did not know what the subcontractor actually wanted. For example, if the subcontractor needed some specific phone accessory, they did not know the actual type of the needed accessory. The Nokia project leader had to deliver randomly some accessory which did not match the original request. Those information flow problems were also caused by cultural differences since

the subcontractor did not know an exact contact that they can use for solving the specific problems. It is typical for subcontractors from this region to ignore a problem they do not know a suitable contact for, leaving the problematic task behind only to be found again later when it is already too late.

6.3 Solving the problems in Project X

When the study of problems was started, it was clearly pointed out that the problems were in logistic, legal and knowledge areas.

During the prototype problem solving it was seen as the best option to also nominate one single prototype contact in the subcontractor's side in that way all of the prototype related information have one owner in both sides and the information flow between Nokia and the subcontractor is fluent enough. Both prototype contacts are familiar with each other so that they can ask if they have anything special in their minds on their side. Figure 3 demonstrates the prototype information flow in the new setup of Project X. The prototype related requests or questions from the subcontractor developers and test engineers must be routed via subcontractor prototype contact to Nokia prototype manager. There must also be communication channels for the subcontractor and Nokia project managers. The subcontractor prototype contact reports to his own project manager and Nokia subcontracting prototype manager reports to the Nokia subcontracting project manager.

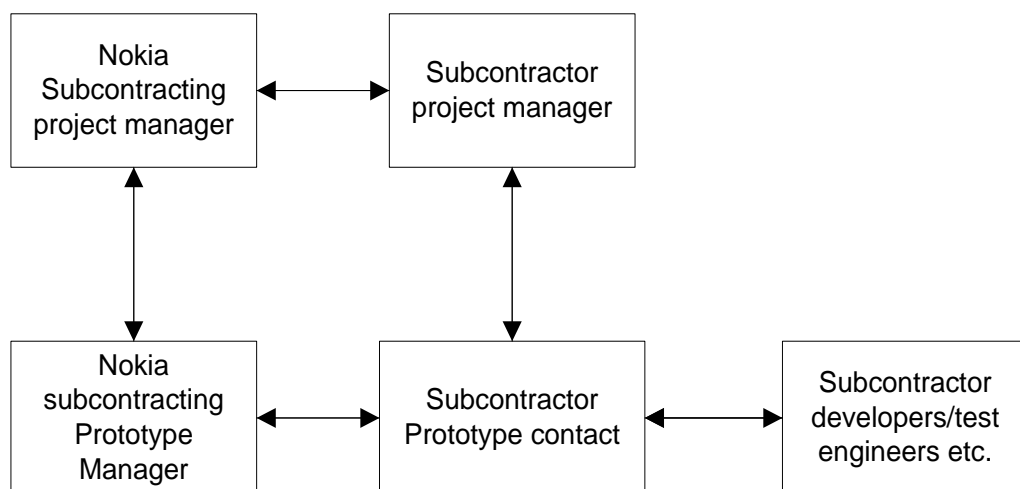


FIGURE 3. Information flow between the subcontractor and Nokia

Studying and benchmarking several deliveries pointed out that the prototype orders in the Nokia internal order tools must be done before an actual need occurs with the subcontractor. Typical prototype order window in the Nokia internal order tools occurs about half a year before the prototype is manufactured. The subcontractors can evaluate their prototype needs about 2-3 weeks before the actual need. If prototypes are requested late in the internal order tools, the prototype amounts cannot be raised anymore. In those cases the prototypes must be taken out from some Nokia internal development unit, which causes a lack of prototypes elsewhere. It is quite important to have official Nokia prototype specialist in the subcontracting project information loop because they have access to the Nokia internal prototype order tools and they can order suitable amounts of prototypes in an early phase. With these actions about one week away was managed to cut from the delivery time, and more buffer was added in order to get the needed prototypes for the project.

After the delivery times and methods had been studied more, it seemed that the package moved quite rapidly from Finland to India, but the final delivery took at least a week or two after the package had arrived to the India customs.

The subcontracting project is located in the same city as one Nokia development unit. Nokia has very good logistics for the internal deliveries, and that is why it was decided to use Nokia's own India unit as delivery hub for the subcontractor. After sending several deliveries via Nokia India unit, the actual delivery time of the package was managed to cut to less than one week, which was fast enough for the development.

The legal problem in the previous prototype deliveries was that a PLA document was not filled correctly and there were several documents without suitable signatures from Nokia's and subcontractor's side. A PLA document requires signatures from the Nokia project leader, the prototype specialist/manager, and one authorized signature from the subcontractor project leader. The PLA problems were solved so that the PLA signed by Nokia's side was sent at the same time straight to the subcontractor when the R&D material packages were sent from Finland to Nokia's India unit. When the subcontractor receives the PLA, they must return it filled and signed when picking up the delivered R&D materials from the local Nokia office. Figure 4 demonstrates the delivery flow for Project X.

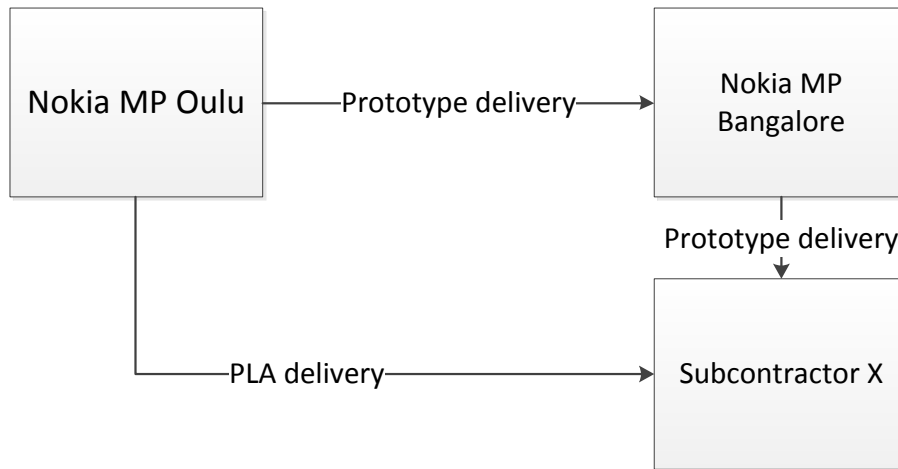


FIGURE 4. Delivery flow for Project X

Because there were not accurate PLAs available for the project old materials which were shipped there earlier, it was decided that someone from Nokia must travel to the subcontractor's site and make a full list of R&D materials available in the subcontractor's premises. One of the new project leaders had a business trip to the subcontractor and agreed to make a list of the items which were in the subcontractor's premises.

6.4 Current state of Project X

For a prototype delivery it takes now typically less than one week to get from Oulu to the subcontractor. Sometimes a delivery is delayed by the Indian customs, but that is something which cannot be affected very much. Also, sometimes some delays are caused by personnel changes on the Indian side, since they are very active in changing their jobs and employers. It takes some time to teach the needed knowledge to the new contacts.

Several small projects have also merged with the same subcontractor to one bigger project and one prototype management for getting more cost savings and better prototype availability in the subcontractor. Now the delivered package amounts have been cut by 50%, which can be seen as a clear cost saving in the delivery area. Also the

prototype amounts in the projects have been decreased due to the merging of several projects to one prototype pool which makes the hardware utilization much higher than it used to be. The project management can now be done with less people since for example only one person has to be allocated in the prototype related area, and another management can be used for several projects instead of having the company's own managers for every project.

Project leading is now moving closer to the creation site of the product, and therefore it is possible to make more cost savings on the package deliveries since there is no need to have the packages sent through Finland. In addition, it is more logical to have all the project management parts in the same place.

7 NEW PROTOTYPE PROCESS FOR SUBCONTRACTING PROJECTS

This chapter defines new prototype process and all the key criterias affecting on that. New process related documentations are also presented on the public level in this chapter.

7.1 Process description

When a new subcontracting agreement between Nokia and some subcontractor is signed and the project setup is started, it is also essential to nominate one person from both sides for handling the R&D material and information flow. Suitable persons from Nokia's side should be those who are already dedicated to working with prototypes and have a very good knowledge about the prototype security incidents and have fluent communication skills. Typically there should be at least one person in every Nokia's MP site who has such a knowledge, and it is recommended to use such persons for handling the subcontractor matters.

Figure 5 demonstrates a new process diagram at a very basic level. Basically the prototype related communications should be done between the subcontractor's prototype responsible and Nokia subcontracting single point of contact. All prototype requests must come via the subcontractor prototype responsible and all prototype deliveries including the PLA papers must be delivered via Nokia subcontracting prototype responsible person. In addition Nokia's person responsible for subcontracting the prototypes must be in a very close contact MP Prototype Management local site prototype responsible person.

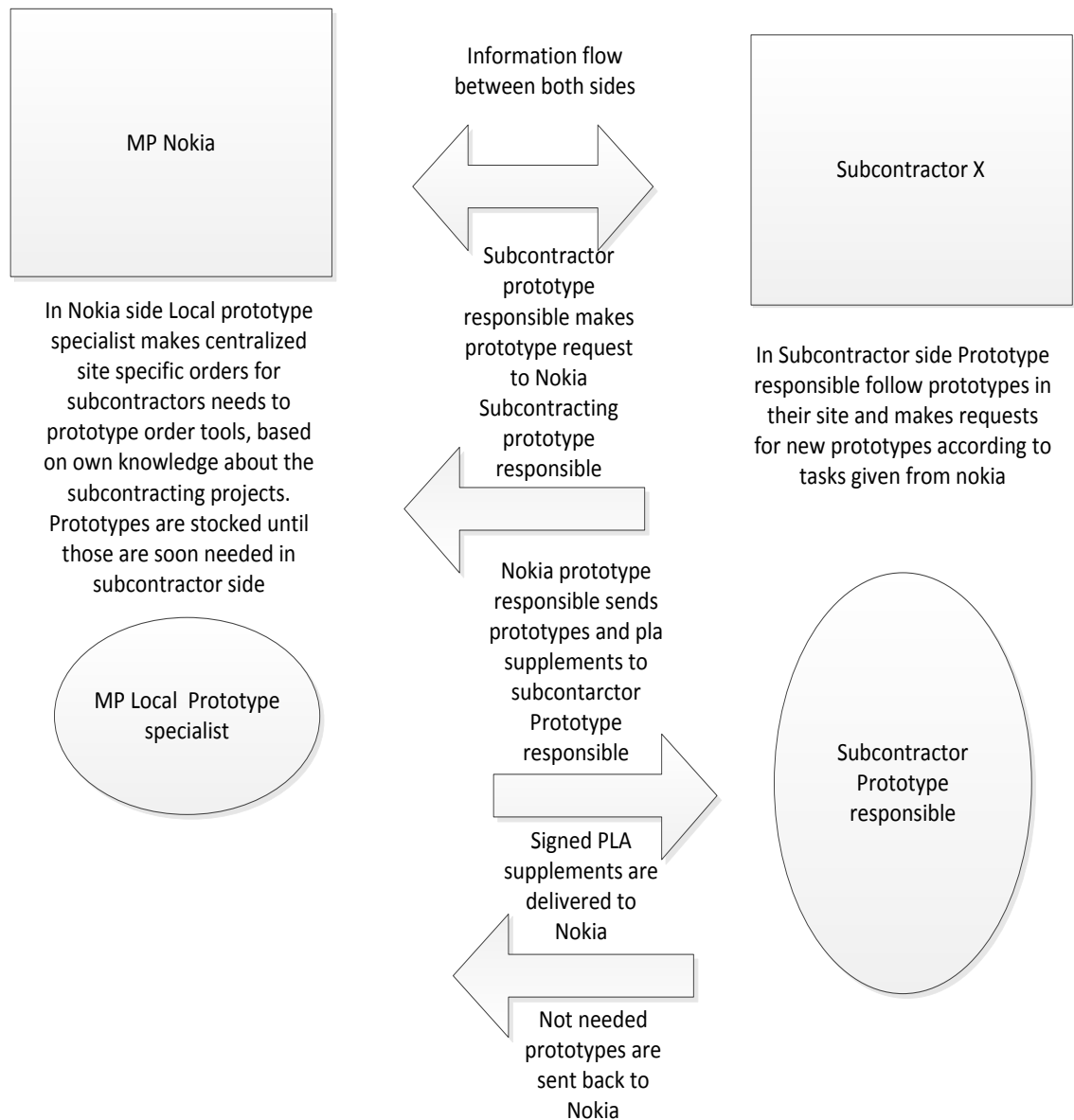


FIGURE 5. Simple process diagram

Detailed internal documentations for the process and the needed additional materials have been made for the use of Nokia's MP. The following subsections describe the created process at a rough level without including any special internal information.

7.2 Cost optimization

One of the main goals in the newly created process is cost savings. Cost savings can be achieved by arranging the deliveries so that the packet sizes are optimized and only one person on both sides is responsible for arranging deliveries to and from the subcontractor. If needed, the global proto specialist network can be used for shipping the items from one continent to another while avoiding extra delivery costs. Also merging several projects with one subcontractor should be done in the way that a single management, prototype and R&D material pool can be used for every project.

7.3 Security

Security must be taken seriously when handling prototype materials. It is important to follow Nokia's internal security guidelines for handling and delivering the prototypes. The couriers preferred by Nokia must be used when sending prototypes. Delivery packages must be plain and well documented for avoiding any hangs and problems in the delivery chain. Export deliveries must follow Nokia's standard delivery routes, where the risks of losing packages are minimized. All delivery packages must have tracking AWBs (Air Way Bill) and those must be followed via the live package tracing tools of the courier. All prototypes and R&D materials must be registered to the official documentation portals when those are sent out from Nokia premises and when received in the subcontractor's side. The package contents must be checked on Nokia's side just before sending the package and on the receiver's side immediately when the package is opened. The subcontractors should not have any material which they do not really need for doing their tasks. Therefore, if the need for some specific product is not valid anymore, those must be recalled back to Nokia. The prototype materials must also be followed in both sides all the time; there must be an updated documentation of the whereabouts of the items which are on the subcontractor's side. Such a document must be available for the subcontractor and for Nokia. (Secure Prototype delivery, 2012.)

7.4 Quality

Quality of the prototype service for the subcontractor should be good. When the subcontractor really needs some items, those must be delivered as agreed. There should not be any information loss between Nokia and the subcontractor. Also support must be given for the technical problems faced in the subcontractor side. All created documents must be written with good quality using Nokia policies. Every area must have clear contact with clear definition about the tasks and responsibilities. Different cultures must be taken into account when communicating with the subcontractor, so that the service is respectful and user friendly.

7.5 Timing

Schedules of the prototype deliveries should be arranged so that subcontractors have the needed materials just before the actual need occurs. Nokia nominated prototype responsible person should order needed materials from the order tool well before actual need occurs and hold items until those should be shipped to subcontractor side. Also timing of recalling items which are not needed anymore in subcontractor side should be done so that subcontractor does not have materials in their responsibility which they do not need anymore. Delivery times should be benchmarked in every delivery, so if there are some changes in routes or customs it can be seen instantly and corrective actions can be taken.

7.6 Flexibility

Flexibility is needed when working in subcontractor area. There are always some urgent unexpected prototype needs in the subcontracting projects. Nokia side contact must be aware of those problems and there are global prototype specialists available for filling those unexpected urgent needs. From the subcontractor side there can be seen also such problems that they won't receive all the items which they need, because of the limitation of prototypes for some certain products. Then the subcontractor must be informed and we must try to find a way to manage without that certain product.

7.7 Documentations for the process

The official project definition documents were made according to the new process. The documents include a step-by-step guide of the steps to follow when starting a new subcontracting project. The documentations include all the security related aspects including the deliveries and prototype classifications. The documentation includes a list of the local contact names with details of the official contacts for arranging the prototype materials for the subcontracting projects.

The official prototype tracking tools are presented and provided in the documentations. Those tools must be used in every subcontractor project. Documentation set also includes detailed guides for sending prototypes and R&D materials in an official way.

All the created documents are classified as Nokia Company Confidential, and therefore they are not attached or explained in more detail in this thesis.

8 IMPROVEMENT SUGGESTIONS FOR HANDLING THE SUBCONTRACTING PROTOTYPE

It has been noticed that there are various subcontracting projects in Nokia. In a typical case there are several different projects in one subcontracting company. All projects have their own contacts and networks. From point of view of logistics and cost it would be reasonable to make a single prototype and R&D material pools for one subcontracting company which has several different subcontracting projects. There should be one top manager from Nokia and one from the subcontractor's side, who are responsible for all projects.

The prototype handling should also be done in the way that there is one prototype contact on Nokia's side for the whole subcontracting company and one contact on the subcontractor side. All subcontracting projects should have one company specific prototype pool where they can borrow prototypes from when a need occurs. If a project has a very special justified need for having some project owned prototypes it can be arranged if the reason is good enough. In this way considerable cost savings can be made and the prototype security is with at a higher level since there are only one prototype receiving and storing point in the subcontracting company and the prototypes are under one single contact responsibility. If this kind of prototype pools are used, it has been proven that the total amount of the delivered prototypes can be much less than if the prototypes are delivered to each project separately.

From the subcontractor's point of view the pooling prototypes are also a good solution. They have a clear view of what they have, and they have one nominated person for organizing the prototypes. When some project suddenly needs some specific prototype for a short time, it can typically be found from the prototype pool, instead of ordering a new one from Nokia. It is much easier to get some new specific prototypes from Nokia to the prototype pool instead of having a project - specific valid business reason to get one prototype for a short use.

On the project management's side there should be one manager watching all different projects in one company. In that way a clear oversight can be received of what is

happening at the company level, the resources can be moved in an efficient way inside the subcontracting company. The project and prototype management in Nokia should be located near the actual creation site of product in order to minimize the internal prototype deliveries between the sites before sending those to the subcontractors.

A new job position and description were suggested as an improvement idea for the R&D material delivery process. A new subcontracting prototype contact should be located at the same place as the project management. The suggested job description includes a list of responsibilities, key deliverables/outputs, success criteria, key competences and criteria, as well as work interfaces for the Nokia subcontracting prototype contact position.

It is very important that everyone handling the prototype devices are very familiar with the Nokia Prototype security policies and requirements. Everyone should participate in the prototype security trainings or at least read the official prototype handling instructions.

9 CONCLUSION

Subcontracting is nowadays an increasing trend in software development companies. It is common to have a subcontractor doing some parts of the development, when companies are looking for cost saving and focusing their own people on the core business. Subcontracting is not free and it is not a shortcut for fastening the development in the company. It always takes some time and extra effort to get new subcontractor working as efficiently as the employing company expects. A well working subcontracting requires a very open and co-operative working mode in both companies.

When passing information and development materials to the subcontractor's hands there is always a risk of accidentally losing some internal sensitive information outside of the company. Security must be taken seriously into account when passing information and development materials to the hands of a 3rd party.

When the information and development material deliveries including handlings are well documented and there is a clear process of how to act in different cases, the process gives an easy and safe way to handle such matters in new subcontracting cases. During this thesis work several studies and benchmarkings were done as daily tasks. There were also some challenges to find the most efficient way to handle the R&D materials in the subcontractor's projects. In the case of Project X many good points were learned for creating an official prototype management process. The actual process definition was done in the way that it looks very simple and is easy to follow even for people who have not been working on the prototypes and deliveries.

During the study and the actual work with the subcontractors it has been proven that every subcontractor has his/her own way to handle problems in their projects. Different cultural backgrounds also gives some culture specific ways to handle the problems which must be accepted with discretion. During the thesis work the internal company structure changed and the project responsables were changed which caused some delay in the actual thesis work schedules. From the company's side the outcome of the thesis was seen as very good, and the produced materials were done with professional quality. It is unfortunate that these materials are only for our internal use, since those would also

have been very good materials for the use for other companies who are facing the same problems in their own subcontracting and material delivery cases.

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